CROSS/ ROADS\
LINKING MOBILITY SOLUTIONS

IRF WORLD ROAD MEETING 2017
/ 14-17 NOVEMBER / DELHI / INDIA /

भा रा रा प्रा NHAI

ADVANCEMENT IN CONCRETE PAVING TECHNOLOGY IN INDIA

Mr. R.K Jain, CE (retd) Hr.PWD
rkjain7343@gmail.com

Mr. B.S. Singla, CGM(T) NHAI
bssingla001@gmail.com

Mr. Asheesh Kumar Jain
Project Director, EPE – I NHAI
asheeshjain41@gmail.com

Earlier Construction

- India had built CCP from 1928 through 1962 by manual methods.

LOCATION	YEAR
Hyderabad city	1928
Chandni Chowk -Delhi	1936
Marine drive- Mumbai	1939
NH4 Bangalore-Mysore road	1950-1955
NH17 Bombay-Goa road	1962
In front of CRRI -New Delhi	1947
NH-2 Faridabad	During sixties

Earlier Methods for Concrete pavement

- Manual methods and light equipment technology.
- The extracted cores confirmed pavement thickness
- Pavement thickness 200 mm (8 inch)
- Maximum size of aggregates 40 mm

Present Scenario

- MORTH decided in 1990 to go in for CCP construction in a big way.

- CCP constructed on NH-2 using half width SF Paver from 1992 to

Improvised Concrete placer

Photo 1993

First Slip form paved highway

Photo 1993

Photo 1994

- 47 km of NH-2 in Haryana and UP taken up 1993.
- Completed in 1997.
- Half width Gomaco company paver used
- 1.5 m wide shoulders in flexible pavement

1st mechanised CCP on DM road NH-2

Photograph 1993

Updation of Codes and Guidelines by IRC

For implementation of modern project, revision / addition of codes essential

•Total no. of Codes / Guidelines	21	
•Already revised		14
•Under revision		06
•Not to be revised		01

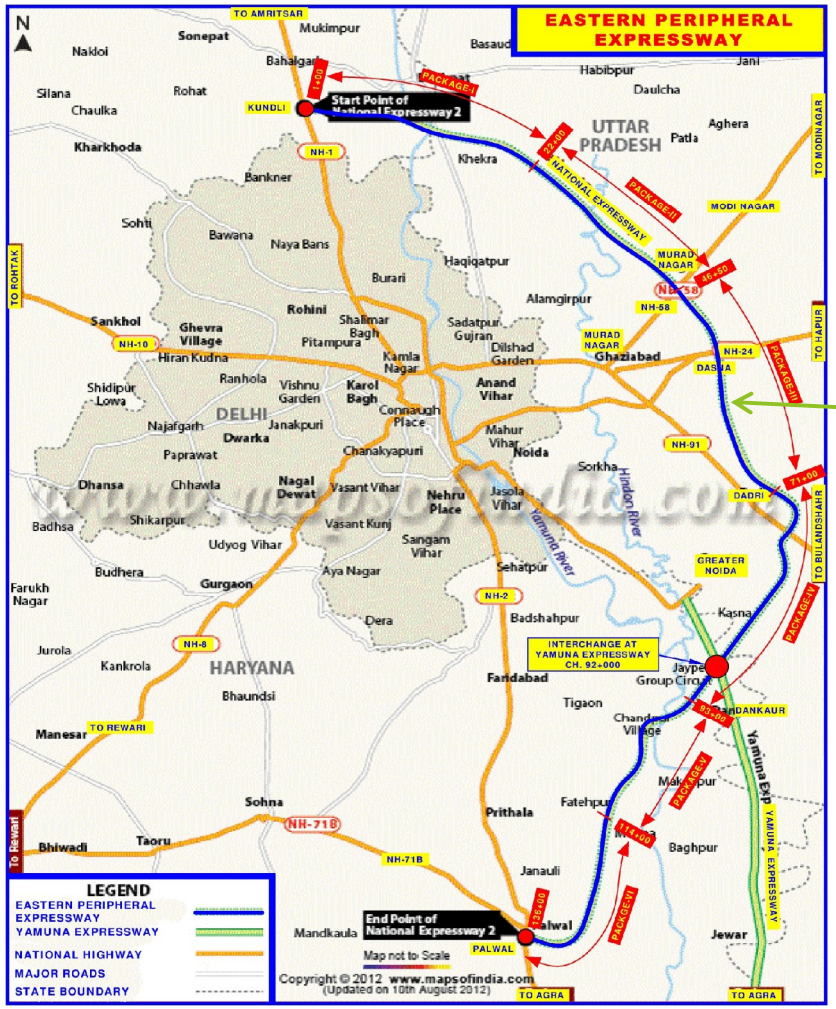
Becoming World leader in concrete pavement

- During the period 2001 to 2005 India constructed maximum kilometres of concrete pavements in the world.
- From year 2001 t0 2005 paved more than 3000 lane km
- The trend continues

Concrete Pavement Equipment

- In 1992, India had one half width SF paver.
- Now, more than 300 pavers.

Eastern Peripheral Expressway



EPE

Eastern Peripheral Expressway

Begins from NH -1 at Kundli and ends on NH -2 at Palwal
crossing 2 states – Haryana & Uttar Pradesh

Access control in the entire	135 km length
Designed as	6 lane, (15 m in each CW)
Speed limit	120km/h

- Eastern Peripheral Expressway will help decongest Delhi
- The 25000 vehicles which used to enter Delhi daily will now ply on EPE
- It will improve the air quality index (AQI) of National Capital

Salient Features

• Cost	Rs. 4418 cr. (6800 Million USD)
• Minor bridges	45
• Major bridges	04
• ROB	08
• Interchange	08
• Flyover	04
• Vehicle underpass	71

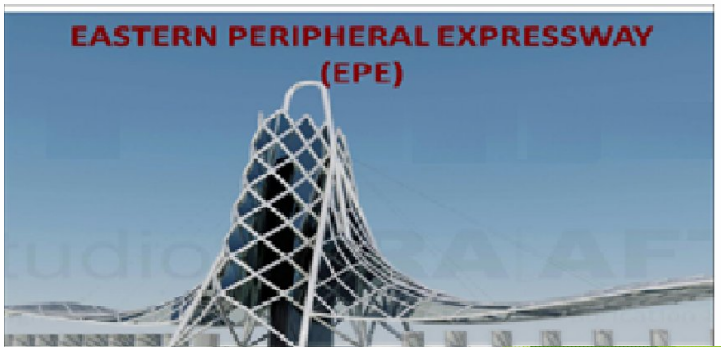
Materials

• Cement	1.02 million MT
• Steel	98,000 MT
• Coarse Aggregates	50 Lac cum (5 million cum)
• Sand	20 lac cum (2 million cum)
• Flyash used in embankment	90 lac cum (9 million cum)

Essential Equipment

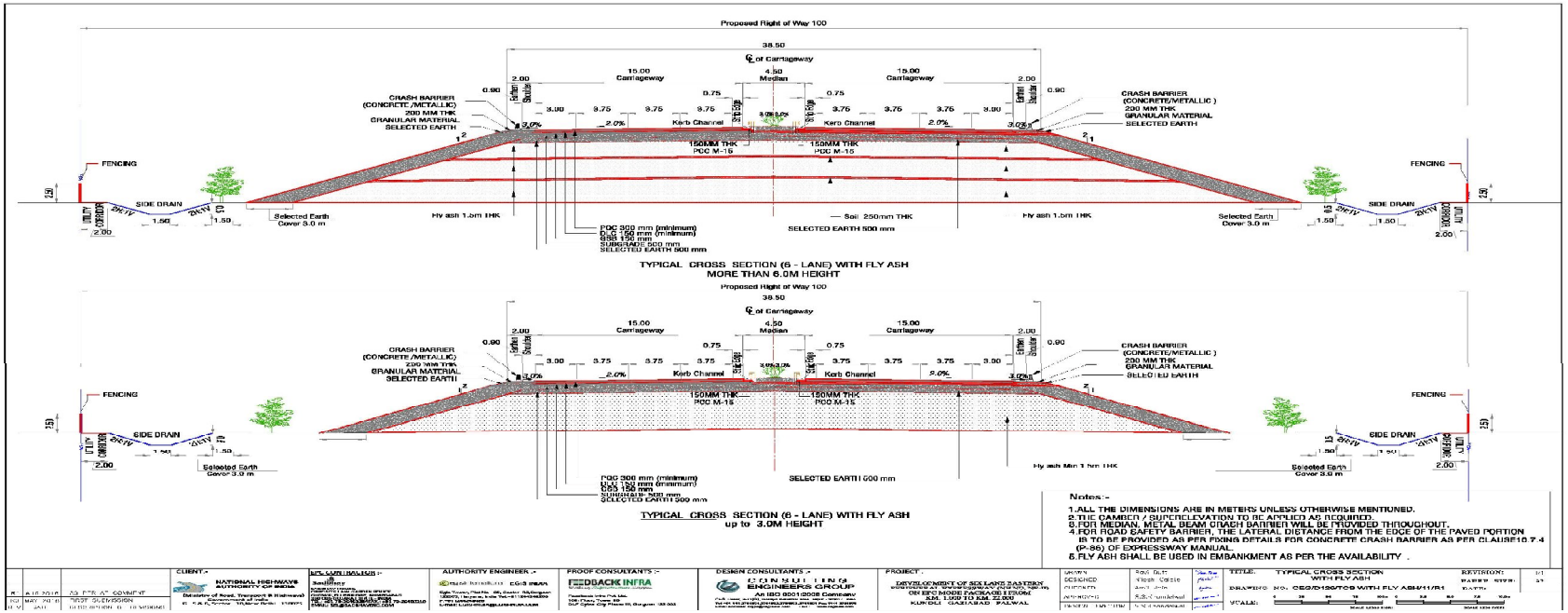
- Slip form paver (15 m) for CCP 08 nos
- Sensor paver for RCC 10 nos
- Mortar graders 90 nos
- Concrete Batching Plants 28 nos

Facilities



- Iconic Main toll plaza 01
- Other Main toll plaza 01
- Toll plazas at each entry and exit of 7 interchanges
- No of trees to be planted 2.5 lac (0.25 million)
- Rain water harvesting system to be provided at every 500 m along the alignment on both sides

EPE - Cross Section



Crust thickness

CCP	300mm
RCC	150mm
GSB	150mm
sub grade	500mm

PROPERTIES OF SOIL

Free Soil Index (FSI)	0-12
Liquid limit (LL)	24-26 %
Plasticity Index	4-7
Maximum Dry Density (MDD)	1.78-1.95 gm/cc
Optimum Moisture Content (OMC)	10-12.5%
CBR	8 to15 %

EPE

Fly-ash & Soil being Compacted & FDD Test being Performed

EW layer	250 mm
Flyash layer	200 mm
Percentage compaction	> 98% against 97%

EPE

Multimat in slope protection with turfing

Geo Composite for internal drainage of soil

Properties of Aggregates

S.No	Description	Coarse aggregates value	Fine aggregates value
1	Specific Gravity gm/cc	2.71 gm/cc	2.62gm/cc
2	Water absorption	0.21 %	1.21 %
3	Deleterious Materials a) Clay & lignite	Nil	Nil
	b) Clay lumps-	Nil	Nil
	c) Materials Finer than 75micron	2.15 %	0.32 %
4	Flakiness Index	11.0 %	-
5	Elongation Index	27 %	-
6	Aggregate Impact Value (AIV)	21 %	-
7	Soundness	0.51%	1.85%

Mix Design of Roller Compacted Concrete

Contd.

Compacted Dry Density	2.347 MT/M^3
Optimum Moisture Content	5.1%
Compressive Strength on 3 days	14.1 N/mm^2
Compressive Strength on 7 days	19.04 N/mm^2

Non-cohesive and segregated texture look in top surface	1:4 cement: sand moist mortar broomed-in and-rolled rendered the top surface smooth

RCC being spread with curing compound

CCP under progress

Non Destructive Testing by MPI

Position of dowel bars tested using MIT SCAN 2 BT

Horizontal or vertical rotational alignment	: ≤ 10 mm over 500 mm length
Longitudinal side shift	: ≤ 50 mm over 500 mm length
Depth	: Mid-depth ± 25 mm

CCP on EPE

Thickness	300 mm
Width in each	CW 15 m
Spacing of transverse joints	4.5 m
Strength of concrete	4.5 Mpa (flexural)
Depth of tines	3-4 mm
Width of joint	8-10 mm
Sealant	polysulphide
Slump at paving site	25 ±10 mm
Ambient temperature	< 35°c
Concrete temperature	< 30°c
Curing period	16 days

Mix Design of Cement Concrete Pavement

contd

28 days Compressive strength of concrete	65.35 N/mm^2
28 days flexural strength of concrete	6.33 N/mm^2
R7 factor of flexural strength	0.8333
Standard deviation of 28 days comp strength	2.96 N/mm^2
Standard deviation of 28 days flexural strength	0.19 N/mm^2
Slump at plant	65 mm
Slump at paving site	25 mm

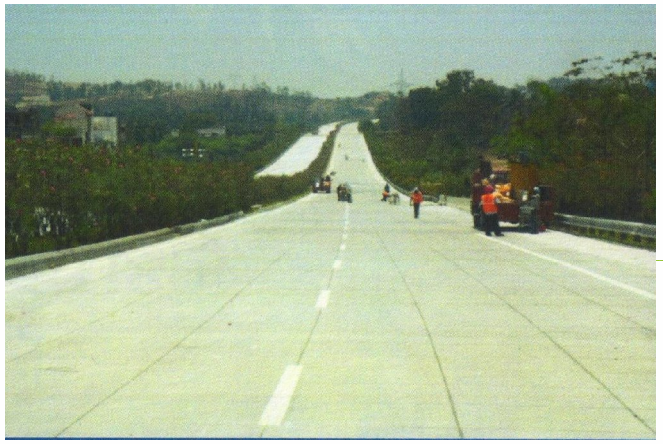
Fuel Saving

Vehicles category	No. of vehicles per day	Type of fuel	Average distance per litter of fuel	Fuel required per vehicle for 135 km (ltr.)	Fuel required per day (ltr.)	Rate of fuel per ltr. (in Rs.)	Total cost of fuel (in Rs. million	Saving in fuel @ 10% (in Rs. million	Total saving per day (in Rs. million	Total saving per year (in Rs. million
Commercial	8,000	Diesel	9 km/1	15	1,20,000	55	6.6	0.66	1.443	527
Cars & Others	12,000	Diesel	18 km/1	7.5	90,000	55	4.95	0.495		
	5,000	Petrol	15 km/1	9	45,000	64	2.88	0.288		

Carbon Credit

Cement used per km (in MT)	Fly-ash Used	Earning Carbon Credits per km	Earning Carbon Credits in 135 km
4000	15%	600	81,000

WHITE TOPPING



UTWT Pune

Bonded TWT NICE road Banglore

Maintenance is nominal and life cycle cost when compared to flexible overlay is less.

CCP in Adverse Conditions

- NH-48 - 3 years ago, CCP constructed in adverse climatic conditions and un-favorable geometrics under supervision of author

- Issues

  Series of curves; simple, compound and reverse

  Falling gradient as steep as 6%

  Radius of some of the curves was as low as 16m

  Annual rain fall is 6600 mm

  Number of heavily loaded trucks and passenger buses is more than 5000 per day

- Length of badly affected reach was 26 km in all, out of which first 12 km was in worst and has been paved

NH 48 - Before CCP

Exiting flexible	Artesian condition water oozing out from flexible pavement

NH 48 - With CCP

CCP laid with 5 m Custom-made paver	Traffic playing after completion of 12 km reach

CRCP under construction in difficult terrain in Pune

Ongoing Initiatives for Improvement

- Research experiments on construction of 500 m stretch of Continuously Reinforced Concrete Pavement (CRCP) with reduced thickness is proposed.

- Availability of hard coarse and fine aggregates and sub grade soil is an ongoing challenge. The shortage of good sub grade soil has been made up upto 33% by use of fly-ash in embankment 90 lac cum (9 million).

•Strengthen existing cement concrete pavement (CCP) by bonded and unbounded method for improving long term viability

•Noise pollution and tyre brusting are critical issues proposed to be solved by laying 30 mm thick anti-skidding bituminous layer

Conclusion

- Some more roads needs to be built in adverse climatic and Geo metric conditions.
- Use of CRCP needs to be taken up immediately.
- Use of Panelled concrete needs to be encouraged.
- Use of 2LCP needs to be taken up vigorously.


सत्यमेव जयते

Thank You

Any ?????????????????? Plz